Recycling wind blades into structural panels for the building material Industry

“Saving the world one square foot at a time!!” Key Project Members:

Neil Rohan & **Miles Gathright** - **Founder**s of **Boardwurks**

1st Question - Innovation

Identification of the Industry gap addressed by the technology

End of life windblades have a disposal problem. You cannot send them to the landfill due to their size and mass. So, if we cannot recycle them, then we cannot build more. Additional windblades will surely be needed to meet the USA ‘s clean energy requirements going forth into the future.

What can we do about this? Windblades can currently be processed via mechanical reduction into FRP fibers. These fibers can then be recycled and used as additives in concrete, mortar, asphalt, and composites. The big question is: Are these markets enough?? Let us assume they are not.

The industry gap that we have found will address the need for additional markets for the FRP blade waste, while providing a path for small business that wish to invest in this market segment. Our innovation is the manufacturing of 4x8 engineered panels and other sheet related products for the Building Material Industry out of FRP blade waste. The hammer mill reduces the input to a consistent size for mixing more efficiently with the binder.

The intent is to manufacture a fiberboard using the FRP waste from windblades (sourced from others) and a binder in a combination that will allow the panel to achieve the top fire ratings and structural panel certifications. This will be our starting point and baseline. Alternate binders are continuously being evaluated.

These panels will be built using a multiple daylight heated hydraulic press which can produce 1000 tons a year of fiberboard panels. Recycled FRP fiber content of the resulting boards will be 50-70% by weight and 90-95% by volume. The mass yield metric would be minimally 50% with a goal of 70%.

The expected density to be in the 50-65 pound per cubic foot density range. These panels should be able to be used residentially and commercially for roof underlayment, subfloors, wall sheathing, countertops, ceilings, and furniture. Building and equipment requirements for this process have purposely been kept on the smaller side in order to reuse empty buildings. Space needed is 3000-5000 square feet (about the area of a basketball court) with 200-300 Amps of 208/220

3 Phase electrical service. All efforts will be made to utilize electricity produced by wind blades for the electrical process needs. With these building requirements, space should be available in nearly all small towns in areas of wind blade concentration. Most notably this would be a corridor between Texas and Iowa as that is where the most windblades are installed.

In keeping with the 1000-ton annual capacity of this small manufacturing plant, possible potential revenue is in the $2.5-3.5 Million range per shift. The square foot pricing, using ½" thickness as a baseline, should fall in the 3-to-5-dollar range. This would allow for a target cost of $100 per 1/2" 4x8 panel. There are also other recycled waste streams and sustainable inputs that can be used in this process.

By 2050, wind blade waste is projected to be 200,000 to 370,000 tons per year. At 300,000 tons per year, 300 of the above plants could be installed in the areas that are close to wind blade processing centers. Less if the proposed facilities are scaled up. At $500k to $750k each installation, the wind blade disposal mitigation could be accomplished for approximately $150-$225 million dollars. This proposal would then be able to create an industry and generate revenue of $900 million (2050) in the building materials industry.

The project work will be completed at the Boardwurks manufacturing facility in New Smyrna Beach Florida. Potential suppliers for recycled wind blade input would be Regen Fibers, or any other wind blade reduction processor.

Question 2 - Potential

Why will your innovation be successful?

This innovation will be successful because we are creating a marketable product and establishing the required supply chain. Initial pricing exercises suggest that the Recycled wind blade 4x8 board will be in the cost range of other cement fiber boards. The intent is also to use small manufacturing plants, close to the source of the input, as they can be built with a minimal investment (< $500k). The challenge here will be to create a new building material industry and the ecosystem and infrastructure it will take to support growth.
There is currently a company, Regen Fibers, working to develop the first step in the supply chain by mechanically reducing the windblades to a saleable and

shippable product. Iowa, where Regen is based, has more windblades than any other states except Texas and Oklahoma. Regen Fibers, when they come online at a later date, will be the supplier of choice. In the meantime, research and development is being done with blade material sourced from TPI and fiberglass trim from local boatbuilders.

The manufacturing process used to make the FRP panels has been ongoing for the last several years. It started as a way to utilize foam dust from a boat stringer manufacturing process and keep it from being sent to the landfill ($). The panels produced are then used in the boat stringer manufacturing process creating circularity for the specified boat stringer kit. The initial R&D started with a T-shirt press and found the need for more heat and pressure. Development continued with a bearing press with hot plates but could only do 2 square feet and needed more temperature and control. A 100 Ton, 100C, two slot hot press capable of 4x4 panels was then designed and built in order to scale up into an actual production process. Even with two slots this press could not keep up with in house demand for the recycled sheets. Move forward and a 500 Ton, 200C, 6 slot Hot Press capable of pressing 4x8 sheets has been ordered and installed. Besides taking product quality up a level, cycle time has come down as we increase the temperature. Discussions are held every day on improving material handling to increase press thruput. Currently the Press capacity is yet to be practically determined but theoretical business models suggest 20 panels per hour is profitable at 4-5 dollars a square foot. Revenue at this rate would be $2-3 Million per year. Can scale from there.

The next level of scale will be either adding a press or a 10x scale up. This can be done with either automation or employees. Or a mix. Depends on the business case. Will make all effort to do provide what is best for our fellow man.

The market is wide open at this point since we are creating a new material to put in it. Given the fire ratings, which are expensive, and the proper certifications, the FRP fiber panels can then be used in residential and commercial construction. Uses here could be roof underlayment, subfloors, ceilings, and furniture. There is also the possibility of competing with fibrous cement products in exterior sheathing.

The intent here is to find partners willing to work in this supply chain. Will need multiple supply chain vendors for product distribution and qualification.

Question 3 – Accomplishments and Team

What have you done to date, and what qualities give you a competitive edge?

The idea of being able to recycle FRP waste has been around in the marine industry for a long time, but there has never been a practical way to accomplish this. At best, it can be ground up to reduce the volume at the land fill. Several years ago, work was started with a wind blade manufacturer and a boatbuilder to convert FRP waste into panels that could be used in the Marine industry to replace phenolic board. Initial samples suffered consistency issues attributed to the process and the quality of the input material. The process concerns have now been addressed with the installation of the 4x8 Hot Press. Temperature and pressure control are vastly improved over the 4x4 press built in house. Temperature and pressure levels are also both much higher than the previous press.

The 4x8 Hot Press was already being installed when the prize was announced. This was done to increase production of both foam dust panels and to develop a new panel product based on hemp, with the goal being a carbon negative building panel. In addition to the foam dust and hemp panels, a variety of panels can be made from other recycled and sustainable inputs. Have also made test panels out of waste streams from CNC table operations (wood and plastic), putty dust from CNC pattern mills, EPS from packaging and linear PVC production waste. Panels from sustainable inputs produced to date, other than hemp, include kenaf, abaca, and coconut coir.

Work done with a local boatbuilder used the FRP trim from FRP boat part production. Since all FRP parts at this plant are open molded, there will always be a flange trim to achieve a finished edge. This trim flange is waste in the process and can be processed easily due to the long narrow dimensions. The initial prototype panels were tested and showed excellent mechanical properties and screw retention, as well a low percentage of water absorption.
Key achievements to date include:

- Manufacturing sample panels out of various recycled and sustainable inputs.
- Initial testing/screening of physical and mechanical properties of sample panel inputs at multiple densities and with different binders.
- Installation and commissioning of the 4x8 Hot Press.

Winning the initiate phase will allow for full manufacturing trials as well as conducting DOE's on process/press parameters and the resulting panel properties. The only issue here is when we will be able to get input from a wind blade processor. In the interim, boatbuilder input will be used as it is remarkably like the Blade material. The boatbuilder input is a large waste stream that can be monetized as well. It will also allow us to determine what testing is needed and/or required for the structural panel certifications.

The two principles in this endeavor are Neil Rohan and Miles Gathright. Both have extensive experience in the marine industry developing materials, processes, and products for various boatbuilding companies. They met 25 years ago when Miles took over the Material and Process Engineering duties at Boston Whaler. Coincidently, Neil held the same position at Boston Whaler earlier in the company's existence but had left to form his own boatbuilding component supply company. Both have the same commitment to material and product sustainability and recycling and want to help others realize this goal as well.

Miles and Neil have been collaborating for the last several years on turning boat plant waste streams into something usable. They were successful in creating boards out of the CNC Dust Collector waste and FRP edge trim. The CNC input was used to create recycled content transom boards and the FRP Input as a potential replacement for extremely expensive phenolic boards. Neil and Miles have formed a partnership in Boardwurks to commercialize this technology and consult with others looking to do the same thing.

Question 4: Community Benefits Plan

1. DEIA

Boardwurks is committed to supporting the development of a more diverse, equitable, inclusive, and accessible workplace to foster the best teamwork and working environment. From the president to the press operators, we will strive for an honest day's work for an honest day's pay.

Goal: To have an ethnically diverse workforce and company culture that reflects each community that our businesses are located in.

2. Energy Equity

The Boardwurks Energy plan will be run solely on electrical power. All efforts will be made to source this electricity from wind, solar, hydro or geothermal.

Goal: Eighty percent of electrical service requirements shall be from renewable energy sources by 2026.

3. **Workforce Implications**

Will explore for historically underserved areas that have an eligible and diverse work force. Areas of interest should be in the geographic area of wind blade reduction.

Our small shop concept can be a new building or an existing building that already has the electrical service required. Reusing old buildings would be preferred to building new. Company operations will employees 4-20 people in each location. Start-up costs will be kept low to encourage small business development.

Goal: Identify 100 new locations for the small shop concept by 2026

Word count = 2057